CM

AS Level Maths Question Countdown
8 days until the 1st exam

Information
• Each of the ten sheets will contain five pure questions and two applied questions.
Pure questions
• Two of the pure questions will be 'standard'.
• Two of the pure questions will be 'problems'.
• The last pure question will involve modelling.
Applied questions
• One of the questions will focus on statistics.
• One of the questions will focus on mechanics.
• On alternate days, the statistics question will look at the large data set. Note that these questions may be brief as opposed to full length exam questions.

Notes to self	

Pure questions – standard

1 Solve the following equations

(a) $5x - 12\sqrt{x} + 4 = 0$, $x > 0$

(b) $2^{2y+2} - 35(2^y) + 24 = 0$

(c) $5\cos^2\theta - \sin\theta - 1 = 0$, $\quad 0 \leqslant \theta \leqslant 360°$

2 (a) Show that

(i) $a^3 - b^3 \equiv (a-b)(a^2 + ab + b^2)$

(ii) $2(a^2 + ab + b^2) \equiv a^2 + b^2 + (a+b)^2$
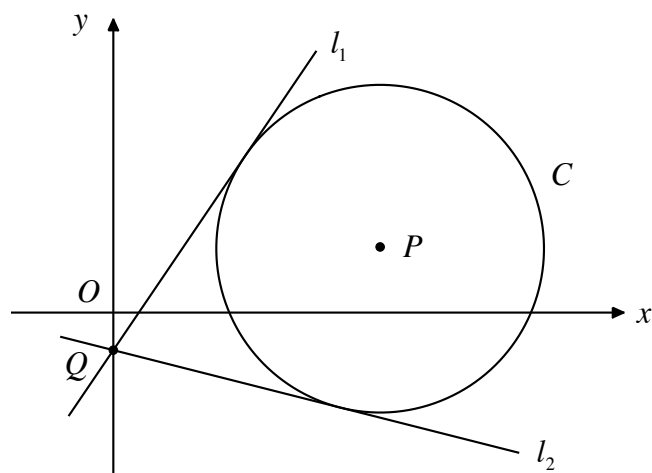
(b) Deduce that $a^2 + ab + b^2 \geqslant 0$ for all a and b.

Simran claims that   "if p and q satisfy $p > q$, then $p^3 > q^3$."

(c) Using the previous parts, prove Simran's claim.

Pure questions – problems

3

The diagram above shows the circle C. The circle C has centre $P(5, 2)$ and radius $\sqrt{17}$.

(a) Show that the equation of C can be given by $x^2 - 10x + y^2 - 4y + 12 = 0$.

The point Q has coordinates $(-1, 0)$.

The lines l_1 and l_2 are tangents to C and both intersect at the point $Q(0, -1)$.

(b) Showing your method clearly, find the equations of the lines l_1 and l_2.

4 The function f is defined such that $f(x) = ax^3 + bx^2 + 5x - 6$, where a and b are constants.

Given that $(x + 2)$ is a factor of $f(x)$,

(a) show that $b - 2a = 4$.

Another factor of $f(x)$ is $(3 - x)$.

(b) (i) Form another equation in terms of a and b.

 (ii) Hence show that $a = -1$ and $b = 2$.

(c) Express $f(x)$ as a product of three linear factors.

(d) Sketch the curve with equation $y = f(x)$.
 On your sketch, show clearly the coordinates of any points where the curve crosses or meets the coordinate axes.

Pure questions – modelling

5 At time $t = 0$, a treatment is started to destroy infected cells of a patient.

A model is created for the number of infected cells N at time t days after treatment begins. The model uses the following assumptions:

- the infected cells grow at a constant rate of 400 cells a day,
- the treatment destroys cells at a constant rate of 450 cells a day,
- at time $t = 0$, the number of infected cells is 8000.

(a) Using the model, find the linear equation relating N and t.

(b) Explain why, according to the model, the treatment will be successful.

(c) Determine the time taken for the number of infected cells to reach 0.

(d) State **one** limitation of the model.

Applied questions – mechanics

6 The particle P moves on the x axis. The acceleration a m s^{-1} of P at time t s varies according to

$$a = 3t^2 - 4, \quad t \geq 0$$

The particle is initially at rest at the origin O.

(a) Find an expression for the velocity v m s^{-1} of P at time t.

(b) Calculate the total distance travelled by P in the first 5 seconds of its motion.

Applied questions – statistics

7 Candice is interested in the distribution of rainfall, r mm, in the UK. To investigate this, she uses the large data set by choosing a sample of size 20 from the 2015 data for 'daily total rainfall' in Heathrow.

To select her sample, Candice labels the 1st May with the number 1, the 2nd May with the number 2, and continues in this way up until the 31st October, which she labels with the number 184. To obtain a sample of size 20, Candice then generates 20 random numbers from 1 to 184 and picks the corresponding data points to add to her sample.

(a) State the name of Candice's sampling technique.

(b) Give **one** reason why Candice's sampling method may not lead to a sample of size 20.

Some of the data points in Candice's sample are labelled 'tr'.
She replaces these values with 0.025 mm.

(c) Using your knowledge of the large data set, suggest how Candice may have decided on this figure.

Candice obtains 20 data points and her data is summarised by the summary statistics below.

$$\sum r = 102.95 \qquad \sum r^2 = 3119$$

(d) Calculate the mean and standard deviation of Candice's data.

Yuganter takes all the 2015 data for 'daily total rainfall' in Beijing.

He wants to calculate some statistics for the data.

(e) Using your knowledge of the large data set, explain why it is better to use the median and interquartile range to analyse Yuganter's data as opposed to the mean and standard deviation.